A Diſcourſe concerning the Muſical Notes of the Trumpet, and Trumpet-Marine, and of the defects of the ſame, by the Honourable Francis Roberts, *Eſq;* R. S. S.

THE Trumpet ſo famous in all Ages for its uſe in War, the lowdneſs and nobleneſs of its ſound peculiarly ſuiting it to that purpoſe, is nevertheleſs to be reckon'd among the imperfect Muſical Inſtruments. For though it has a large compaſs, the greater part of the intermediate Notes are wanting, and ſome of them imperfect. The extent of this Inſtrument cannot be ſtrictly determined, it reaches as high as the ſtrength of the breath can force it, but by conſidering its Notes within the ordinary compaſs of the Scale of Muſick (from double *C fa-ut* to *C ſol-fa* in *alt*) the nature of the higher Notes will plainly appear. Theſe are all ſet down in the Table (Fig. 1.) only take notice that the Prickt Notes are imperfect, not being exactly in Tune, but a little flatter or ſharper than the places where they ſtand, according as *f* or *s* is ſet over them.

Here we may make two inquiries.

1. Whence it comes to paſs that the Trumpet will perform no other Notes (in that compaſs) but only thoſe in the Table, which are uſually called by Muſicians Trumpet-Notes.

2. What is the reaſon that the 7th. 11th. 13th and 14th. Notes are out of Tune, and the others exactly in Tune.

In this matter we may receive ſome light from the Trumpet-Marine, an Inſtrument though as unlike as poſſible to the Trumpet in its frame (one being a Wind-Inſtrument, the other a Monochord) yet has a wonderful agreement with it in its effect. The

The ſound is ſo like as not to be eaſily diſtinguiſhed by the niceſt Ear, and as it performs the very ſame Notes, ſo it has the ſame defects as a Trumpet, for if the String be ſtop'd in any part, but ſuch as produces a Trumpet Note, it yields a harſh and uncouth (not a Muſical) ſound.

Let us therefore proceed to our firſt Inquiry, and examine what is the reaſon that the Trumpet-Marine will perform no other but the Trumpet Notes.

It is a known Experiment of two Uniſon Strings, that ſtriking one of them moves the other, which probably proceeds from hence, that the impulſes of the Air which are made by one String, do more eaſily ſet another in motion which lies in a diſpoſition to have its vibration *Synchronous* to them, than a third whoſe motion would be croſs.

We may improve this a little farther, by obſerving that a String will move not only at the ſtriking of a Uniſon, but an 8th. or 12th, though after a different manner.

If a Uniſon is ſtruck, it makes one intire vibration in the whole String, as in Fig. *A*, and the motion is moſt ſenſible in the middle at *m*, for there the vibrations take the greateſt ſcope.

If an 8th. is ſtruck, it makes two vibrations, as in Fig. *B*, and then the point *m* is in a manner quieſcent, and the moſt ſenſible motion at *n*, *n*.

If a 12th. be ſtruck, then it makes three vibrations, as in Fig. *C*, and the greateſt motion at *q*, *m*, *q*, and hardly to be perceived at *p*, *p*. All which may be plainly experimented by putting a little piece of Paper upon the ſeveral parts of the String to make the motion more conſpicuous.

So that in ſhort this Experiment holds when any Note is ſtruck which is a uniſon to ſome *aliquot part* of the String, as in the former Examples, an 8th. is uniſon to half the String, and a 12th. to a third part of it.

In this caſe (the vibrations of the equal parts of a String of being *Synchronus*) there is no contrariety in their motion to hinder each other, whereas it is otherwiſe if a Note is uniſon to *ſ*, in the Fig. *D*, that does not divide the String into equal parts, for then the vibrations of the remainder *r* not ſuiting with thoſe of the other parts, immediately make a confuſion in the whole.

Now in the Trumpet-Marine you do not ſtop cloſe as in other Inſtruments, but touch the String gently with your Thumb, whereby there is a mutual concurrence of the upper and lower part of the String to produce the ſound. This is ſufficien ly evident from that, if any thing touches the String below the ſtop, the ſound will be as effectually ſpoiled as if it were laid upon that part which is immediately ſtruck with the Bow.

From hence therefore we may collect, that the Trumpet-Marine will yield no Muſical ſound but when the ſtop makes the upper part of the String an *aliquot* of the remainder, and conſequently of the whole; otherwiſe as we juſt now remark'd of Fig. *D*. the vibrations of the parts will croſs one another, and make a ſound ſuitable to their motion, altogether confus'd.

Now that theſe *aliquot parts* are the very ſtops which produce the Trumpets Notes ſhall be plainly ſhown in treating of the ſecond enquiry, *viz.* What is the reaſon that the 7th. 11th 13th and 14th. Notes are out of Tune, and the reſt exactly in Tune.

All Writers of the Mathematical part of Muſick agree

That by ſhortning a String { half, a third part, a fourth, a fifth, a ſixth } the ſound is rais'd { an eighth, a fifth, a fourth, a ſharp third, a flat third. }

From

From this Foundation all the other Notes are derived. The flat and ſharp ſixth are to be the flat and ſharp third to the fourth; and the ſeventh the like to the fifth: the ſecond to be a fifth to the fourth below, *&c.* By this Rule let us examine what Notes a Monochord fretted in its aliquot parts will produce

Suppoſe the Monochord *F* to conſiſt of 720 parts, and its Tone double *C fa-ut* the firſt Note in the Table; then half of it will be 360, and a third part 240, *&c.*

Now I ſay, fretting, (or ſtopping with the Thumb) at 360 muſt produce *C fa-ut*, becauſe 360 being half 720, the ſound will riſe an eighth from double *C fa-ut.*

Again 360 being *C fa-ut*, 240 muſt make *G ſol-re-ut* the third Note in the Table, becauſe 240 being juſt a third part leſs than 360, the ſound will riſe a fifth from that Note After the ſame manner proceeding ſtep by ſtep it will be evident that,

180		240		a 4th.		*C ſol fa-ut* the 4th.	Note in the Table.
144						*E lami*	
120							
90	which					*C ſol fa*	8th
80	is leſs	120	juſt	a 3d	produces	*D la ſol*	9th
72	than	90	by	a 5th		*E lami*	10th.
60		90		a 3d.		*G ſol re ut*	12th
48		60		a 5th.		*B fabimi*	15th
45		90		half.		*C ſol fa*	16th.

By the ſame Reaſon,

100	which	120	juſt	a 6th.	produces	*B fabimi* flat,
67½	is leſs	90	by	a 4th.		*F fa-ut*,
54	than	67½		a 5th		*A lamire*,
50		100		half		*B fabimi* flat.

And Conſequently

102 6/7	the 7th.	Note in	flatter	than	*B fabimi* flat,
65 5/11	11th.	the Ta-	ſharper		*F fa-ut*,
55 5/13	13th.	ble is a	flatter		*A lamire*,
51 3/7	14th.	little	flatter		*B fabimi* flat.

Which anſwers the ſecond Inquiry

Now

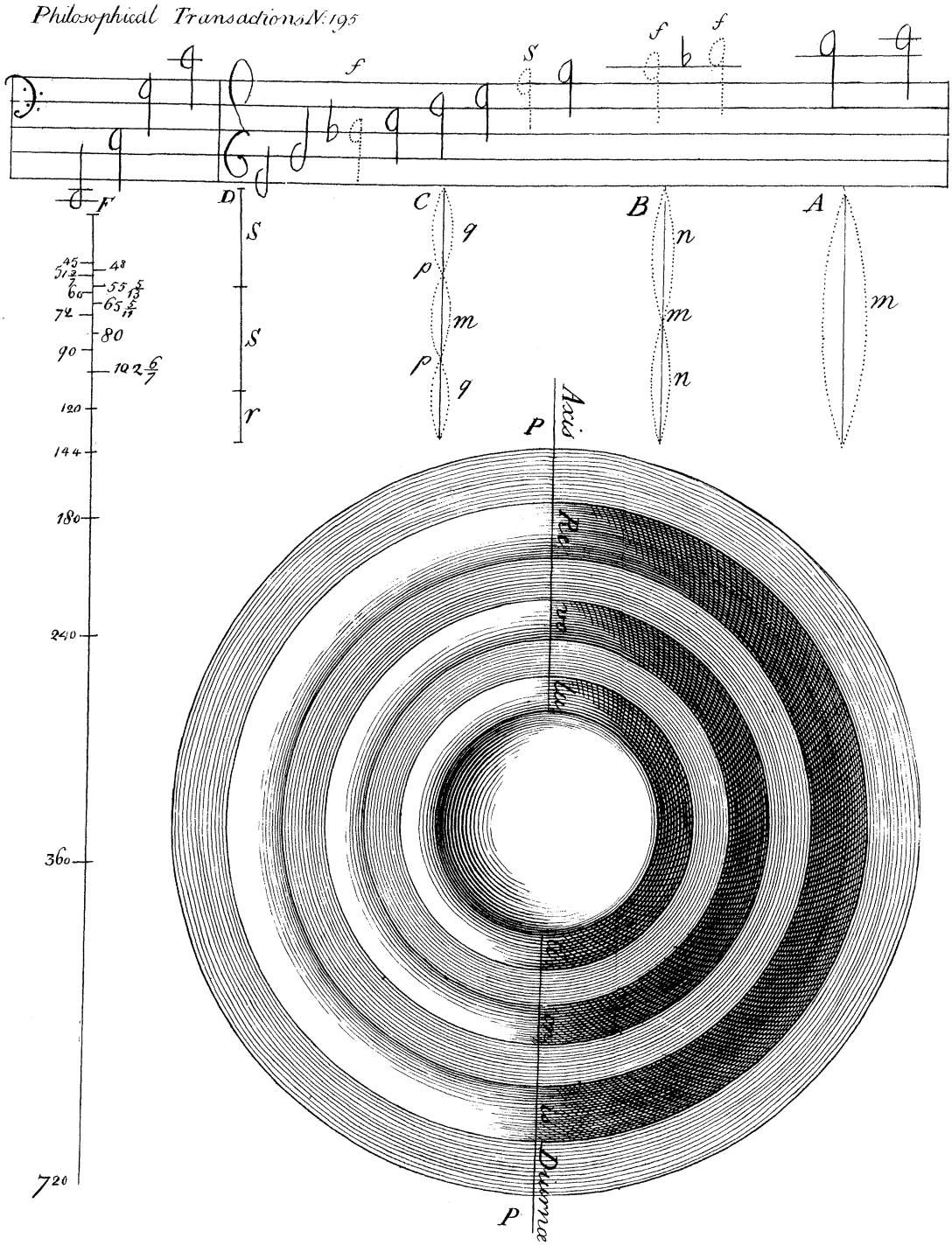
Now to apply this (in a few words) to the Trumpet, where the Notes are produced only by the different force of the breath; it is reaſonable to imagine that the ſtrongeſt blaſt raiſes the ſound by breaking the Air within the Tube into the ſhorteſt vibrations, but that no Muſical ſound will ariſe unleſs they are ſuited to ſome aliquot part, and ſo by reduplication exactly meaſure out the whole length of the Inſtrument, as in Fig. *C*, for otherwiſe a remainder will cauſe the ſame inconvenience in this caſe, as in Fig. *D*. To which if we add that a Pipe, being ſhortned according to the Proportions we even now diſcours'd of in a String, raiſes the ſound in the ſame degrees, it renders the caſe of the Trumpet juſt the ſame with the Monochord.

For a Corollary to this Diſcourſe, we may obſerve that the diſtances of the Trumpet Notes aſcending, continually decreaſed in proportion of $\frac{1}{1}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{5}$ in *infinitum*, For,

The { ſecond / third / fourth } { Note in the Table, differs from the } { firſt / ſecond / third } by { $\frac{1}{2}$ / $\frac{1}{3}$ / $\frac{1}{4}$ } { of the String, &c. }

An Account of the cauſe of the Change of the Variation of the Magnetical Needle; with an Hypotheſis of the Structure of the Internal parts of the Earth: as it was propoſed to the Royal Society *in one of their late Meetings. By* Edm. Halley.

SOme years ſince I publiſhed in theſe Tranſactions, (Numb. 148,) a Theory of the Variation of the Magnetical Compaſs, wherein having collected as many Obſervations as at that time I could procure, and having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Axis
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